

REMARKSClaim Rejection Under 35 U.S.C. § 103(a)

Claims 1 - 17 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over Kirkpatrick (U.S. Patent Application 2006/0084229 in view of Itoh (U.S. Patent Application 2004/0058279).

The Kirkpatrick et al. application, which was published on April 20, 2006 (as Pub. No. 2006/0084299), was filed on December 2, 2005, while the present application was filed on April 2, 2004. The application which was published on April 20, 2006 does not qualify as a reference under 35 U.S.C. §103(a), which requires that the differences sought to be patented must be obvious over the prior art. That which is prior art is defined under 35 U.S.C. § 102.

Failure of the U.S. Patent Application reference 2006/0084229 to Qualify as Prior Art Under 35 U.S.C. § 103(a):

As discussed above, in determining that which qualifies as prior art for consideration under 35 U.S.C. § 103(a), the courts look to subject matter which meets the requirements for prior art under 35 U.S.C. §102.

35 U.S.C. § 102 (a) requires that, to be eligible as prior art, a referenced description must be patented or described in a printed publication in this or a foreign country before the invention of the subject matter described by the applicant for patent. In the present instance the Examiner has cited a patent application and not a patent. Further, the reference cited was not published before the invention was made by the present applicants. The present patent application was filed by the applicants on April 2, 2004, more than 2 years before the publication of the reference cited. The invention was made some time before the date of application, and therefore U.S. Application 2006/0084229 does not meet the requirements for prior art under 35 U.S.C. §102(a).

35 U.S.C. § 102(b) requires that, to be eligible as prior art, a referenced description must be patented or described in a printed publication in this or a foreign country more than one year prior to the date of the application for patent in the U.S. As discussed above, the 2006/0084229 U.S. patent application was not patented and was not described in a printed publication in this or a foreign country more than one year prior to the date of application by the present applicants. Therefore, this reference cited does not meet the requirements for prior art under 35 U.S.C. § 102(b).

None of the other sections under 35 U.S.C. § 102 are applicable with respect to Published Application 2006/0084229, and therefore, this reference does not meet the requirements for prior art under 35 U.S.C. § 103(a).

Qualification of Other References Related to 2006/0084299 US as Prior Art Under 35 U.S.C. § 102:

35 U.S.C. § 102 (a) requires that, to be eligible as prior art, a referenced description must be patented or described in a printed publication in this or a foreign country before the invention of the subject matter described by the applicant for patent. In the present instance, as applicants discussed in their Amendment “A”, the published application cited by the Examiner claims priority under U.S. Application No. 10/752,885, which was filed on January 6, 2004; however, this application was not published until December 30, 2004, and did not issue as a patent until March 28, 2006. Therefore this reference does not qualify as prior art under 35 U.S.C. § 102(a) against the subject matter described in the present application, which was filed (and therefore invented prior to) April 2, 2004. Further, Provisional Application 60/438,112, from which Application No. 10/752, 885 claims priority also does not qualify as prior art under 35 U.S.C. §102 (a) because the provisional application did not issue as a patent and was not described as a printed publication as required.

35 U.S.C. § 102(b) requires that, to be eligible as prior art, a referenced description must be patented or described in a printed publication in this or a foreign country more than one year prior to the date of the application for patent in the U.S. for the subject matter described by the present applicant. As discussed above, the 10/752,885 application was not patented or printed in a publication in this or a foreign country more than one year before the present applicants' filing date of April 2, 2004. Further, Provisional Application 60/438,112, from which Application No. 10/752,885 claims priority also does not qualify as prior art under 35 U.S.C. §102 (b) because the provisional application did not issue as a patent and was not described in a printed publication as required.

35 U.S.C. § 102(e)(1) requires that, to be eligible as prior art, a referenced description must be described in an application for patent, published under section 122(b), and must be filed by another in the United States prior to invention by the applicant for patent. U.S. Application No. 10/752,885, which was filed on January 6, 2004, which was published as U.S.2004/0266113 on December 30, 2004, and which issued as U.S. Patent No. 7,018,925 would qualify as a reference under 35 U.S.C. §102(e)(1) if applicants' invention were not made prior to January 6, 2004. However, Provisional application 60/438,112 does not qualify as published under section 122(b), because provisional applications are not published under section 122(b), but are an exception to applications which are published under section 122(b). Therefore, the Provisional Application No. 60/438,112 can not qualify as prior art under 35 U.S.C. § 102(e)(1).

35 U.S.C. §102(e)(2) requires that the invention be described in a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of subsection 102(e)(2) of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Applicants contend that the application filed as Provisional Application No. 60/438,112, on Jan 6, 2003 does not qualify under U.S.C. § 102(e)(2) because no patent was granted on the application having serial number 60/438,112. This Provisional Application was permitted to go abandoned. The application which was granted was Application No. 10/752,885, filed on January 6, 2004, which issued as U.S. Patent No. 7,018,925 on March 28, 2006.

Therefore, Provisional Application No. 60.438,112, does not qualify as a prior art reference which may be cited under 35 U.S.C. § 103 (a). U.S. Patent 7,018,925 would qualify as a prior art reference which may be cited under 35 U.S.C. § 103(a) if applicants' invention were not made prior to January 6, 2004.

In response to the first Office Action, dated January 24, 2007, Applicants filed Amendment "A" on April 30, 2007. Applicants did not file a Declaration of Prior Invention under 37 C.F.R. § 1.131 at that time, because of the time which would be required to obtain inventor signatures, and because applicants are convinced that there is a clear distinction between the subject matter described in their present application and the subject matter described in U.S. Patent No. 7,018,925. However, applicants did reserve the right to file such a Declaration in the event the Examiner did not agree that applicants' invention is distinct from the subject matter described in U.S. Patent No. 7,018,925. The Examiner continues to argue that applicants' invention is obvious over this reference in combination with another reference, and therefore applicants are submitting a Declaration Of Prior Invention Under 37 C.F.R. § 1.131 in combination with this Response "B".

Because the research and development arm of the division of Applied Materials, Inc. which employed the present inventors has been closed, the current location of all of the inventors is not known. However, the Invention Alert, which is being submitted in support of the accompanying Declaration Of Prior Invention Under 37 C.F.R. § 1.131, exhibits the signature of all of the inventors, which predate January 6, 2004. The Declaration of Prior Invention exhibits the

signature of the first named inventor and two other inventors whom we were able to locate at this time.

In view of the Declaration Of Prior Invention Under 37 C.F.R. §1.131, the Examiner is respectfully requested to withdraw the rejection of Claims 1 - 17 as rejected under 35 U.S.C. §103 (a) as being unpatentable over Kirkpatrick, U.S. Patent No. 7,018,925 (U.S. Patent Application 2006/0084229) in view of Itoh (U.S. Patent Application 2004/0058279).

Despite the removal of the Kirkpatrick reference from consideration based on the requirements for prior art under 35 U.S.C. § 102, applicants also want to make it clear that they continue to contend that the subject matter currently pending in their application is allowable subject matter over the Kirkpatrick U.S. Patent No. 7,018,925 in view of Itoh. For purposes of appeal, if necessary, applicants want to re-assert their principal arguments herein.

In rejecting Claims 1 - 17 under 35 U.S.C. § 103(a) in view of the Kirkpatrick U.S. Patent No. 7,018,925 in combination with Itoh (U.S. Patent Application 2004/0058279), the Examiner indicates that factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148; U.S.P.Q. 459 (1966) should be applied. Applicants contend that the Examiner has not made a *prima facie* case for obviousness in view of a factual inquiry as set forth in *Graham v. John Deere Co.*

The factors which are said to be applied for establishing a background for determining obviousness under 35 U.S.C. § 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or non obviousness.

1. Determining the scope and contents of the prior art.

U.S. Patent No. 7,018,925 to Kirkpatrick, which has the same application specification as the Patent Application Publication 2006/0084229 will be referred to in this response for reference purposes. The Itoh (U.S. Patent Application 2004/0058279) reference will also be referred to in this response for reference purposes.

The Specification of the Kirkpatrick '925 patent describes and claims a method of fabricating a dual gate semiconductor device which includes a nitridated, high voltage dielectric within a low voltage region. The method includes a step in which "an accelerant residue" from the photoresist which is present on the exposed surface nitridated dielectric layer is removed by application of a high vacuum to the surface of the semiconductor device substrate.(Col. 2, lines 25 - 36.)

The present application relates to a method of fabricating a photomask. Patterning radiation is passed through the photomask to expose a photoresist present on a semiconductor device surface during fabrication of the device.

The methods of fabrication of a photomask differ substantially from the methods of fabrication of the semiconductor device. The photomask physical structure is not even similar to that of a semiconductor device in general, and is particularly different from the semiconductor device described in the Kirkpatrick reference.

The Itoh Patent Application relates to a problem of constantly changing size of a latent pattern which is being written into a photoresist using a direct write process. This change in dimension of the written latent pattern is significant because it takes a long period of time (8 - 20 hours) to direct write (write with an electron beam, for example) an entire pattern over a photoresist surface. This compares with patterning done by blanket radiation through a mask (which happens in seconds). The Itoh reference describes a specialty material for use in pattern formation (a photoresist material) for electron beam lithography, which contains an alkali-soluble resin, a photoacid generator and dissolution inhibiting groups. The invention also provides a

method of photomask fabrication which makes use of the specialty photoresist material. The Itoh reference teaches an invention which is clearly distinguishable from applicants' invention, but it is related to the fabrication of a photomask.

2. Ascertaining the differences between the prior art and the claims at issue.

As discussed above, the Kirkpatrick reference relates to a method of fabricating a dual gate semiconductor device which includes a nitridated, high voltage dielectric within a low voltage region. The method includes a step in which, after development of a patterned photoresist (which development process has left "an accelerant residue" from the photoresist on the exposed surface of a nitridated dielectric layer), a high vacuum is applied to the surface of the semiconductor device substrate to remove the accelerant residue from the surface of the nitridated dielectric layer. (Col. 2, lines 25 - 36.)

The method of the present invention, which pertains to photomask fabrication does not describe the use of a high vacuum to remove accelerant residue from a surface of a nitridated dielectric layer. The present invention uses a vacuum to assist in providing an improvement in critical dimension and uniformity of a patterned photoresist. (Paragraph [0014] Application Specification , Page 5, lines 3 - 5.) The photoresist is used to pattern a radiation-blocking layer of the mask, which is typically a chrome layer which is plasma etched through the patterned photoresist. The photomask structure does not include a nitridated dielectric layer, and there is no "accelerant residue" to be removed from such a nitridated dielectric layer.

In the embodiments of the present invention claimed in Claims 1 - 3, the equilibration process is carried out prior to the development of the pattern in the pattern imaged photoresist. The pattern imaged photoresist is a non-developed, continuous layer of photoresist which has been exposed to radiation to create a latent pattern within the continuous layer of photoresist material. Applicants apply a vacuum to this continuous layer of photoresist material to assist in the equilibration of the latent image of the pattern within the continuous layer of photoresist

material. (Paragraph [0015] Specification, Page 5, lines 7 - 13) There is nothing in the Kirkpatrick et al. disclosure which relates to stabilization of a latent image of a pattern within a continuous, non-developed photoresist layer.

In other embodiments (including Claims 8 and 15), applicants wet develop the pattern imaged photoresist (to remove photoresist material which was exposed to radiation, creating openings in the photoresist) prior to applying a vacuum. In this instance, the application of vacuum is used to remove development by-products, moisture, and solvents from the developed photoresist, as a means of improving the line edge roughness of pattern openings which were created in the photoresist. (Paragraph [0017], Specification, Page 6, lines 20 - 22, for example) .

One skilled in the art reading a disclosure teaching about the removal of “accelerant residue” from the surface of an exposed nitridated high voltage dielectric layer in a dual gate semiconductor device would have no reason to relate this technology to a method of fabricating a photomask.

The overall subject matter of the present application is so far removed from the overall subject matter of the Kirkpatrick et al. reference that one of skill in the art would have no reason to consider the description in this reference when working to develop a method of controlling the critical dimensions and uniformity achieved in a photomask radiation blocking layer. The Examiner has not presented a *prima facie* case for anticipation, nor a *prima facie* case for use of the Kirkpatrick et al. description as a reference against the presently claimed subject matter.

The Examiner has cited the Kirkpatrick et al. reference because both the Kirkpatrick et al reference and the present invention make use of a vacuum which may be applied at room temperature for a time period of minutes to hours. However, a vacuum may be applied at room temperature for a time period from minutes to hours in all kinds of processes which are used in industry in general. The use of a vacuum in a different process which is unrelated to the current process does not even suggest the current process.

The Itoh et al. reference, U.S. Patent Application 2004/0058279, published March 25, 2004 is a divisional application of U.S. Application No.09/812,688, filed on March 21, 2001, which issued as U.S. Patent No. 6,660,455 on December 9, 2003. The Itoh et al. reference describes a specialized photoresist material which has been developed to compensate for problems observed when an e-beam is used as the radiation tool to image a chemically amplified photoresist. (Col.1, lines 33 - 59; Col. 2, lines 54 - 68; and Col. 3, lines 42 - 44.) In particular, the specialized photoresist material comprises an alkali-soluble resin; a photoacid generator, which generates an acid when irradiated with an electron beam; and a combination of first and second dissolution inhibiting groups. The first dissolution inhibiting group increases the sensitivity of the pattern formation when left to stand under conditions of the kind which are present during writing of a pattern on a photoresist by an e-beam, which operates under a vacuum. The second dissolution inhibiting group decreases the sensitivity of the pattern formation when left to stand during writing of the image. By controlling the ratio of the first dissolution inhibiting group to the second dissolution inhibiting group, “the portion (of the photoresist) made soluble (in the alkali solution used to develop the photoresist) by exposure of the photoresist to e-beam radiation is substantially held constant independently of the time required to write the pattern over the entire photoresist. That is to say that the amount of time required to write the image, using an e-beam in a system does not affect the size of the pattern which is written, regardless of the time required to write the pattern. (Col. 3, lines 38 - 65.)

Figure 2 of the Itoh reference shows the change in the size of the image which is written by the e-beam as a function of time. For experimental purposes, an image was written on several samples, each of which was then allowed to “stand in a vacuum” for a different time period. The dimensional changes of the individual samples were subsequently plotted on a graph. Each aging sample was placed in a vacuum box for its aging time period, because e-beam writing is carried out under a vacuum. This was an attempt to imitate conditions which would be experienced by the photoresist during e-beam writing of an image. Since the dimension of the irradiation beam

written by the irradiation tool remains constant, the difference between the initially written pattern dimension and the pattern on an aged test specimen represents the changing size of the image which is being written a subsequent time, which is dependent on the molar ratio of the first and second dissolution groups present in the photoresist. (Col. 9, lines 19 - 39.)

It is important to point out that after careful review of the Itoh reference, applicants' attorney was not able to find any indication of the amount of vacuum which was applied during the testing of the various materials which were evaluated as potential photoresist materials. While there is a reference to "standing under vacuum", there is no specification of any units for the vacuum. Not only does the description in the Itoh reference fail to indicate the amount of reduced pressure which is used, but it fails to even suggest that vacuum be applied subsequent to the e-beam writing of a latent image into a photoresist. The only concern is whether the proper evaluation of photoresist materials is made in view of the process used for writing of the image.

There is no vacuum treatment step in any of the Itoh et al. reference claims. This is because the vacuum referred to is not part of the process of developing a pattern in the photoresist and using the patterned photoresist as a etch mask for transferring the pattern to a radiation-blocking layer of the mask. Instead, the mention of the presence of a vacuum was merely part of an experiment to illustrate how the dissolution inhibiting groups present in the photoresist materials would perform during e-beam writing of a pattern latent image into the photoresist.

There is nothing in the Itoh et al. reference which even suggests that a complete photomask including a photoresist already containing a latent pattern image for the mask should be subjected to a vacuum to alter the overall behavior of the already-imaged photoresist in subsequent processing steps.

The present invention makes use of a direct write laser or an electron beam to write a latent image into a photoresist. (Application Specification Paragraph [0006] at Page 1 lines 24 - 26, and Claims 4 and 5, for example.) However, applicants are not developing a specialized photoresist (a specialized pattern formation material) in an attempt to provide an irradiated image

dimension which remains substantially constant over an extended period of pattern writing time. Applicants are leaving this effort to the manufacturers of the photoresist materials.

Applicants are trying to improve the performance of the photoresist subsequent to writing of the pattern into (imaging of) the photoresist. Applicants determined that, for any of the chemically amplified photoresists, it is helpful to use a processing step in which a vacuum ranging between  $5 \times 10^{-6}$  mTorr to about 5 mTorr is applied to the photoresist after completion of writing the irradiated pattern. Exposure of the imaged photoresist to the specified vacuum improves the critical dimension and uniformity of the imaged pattern in the photoresist. This vacuum treatment “allows reaction by-product (which remains after pattern irradiation), water vapor, and solvents, for example to desorb from the surface of the resist, improving critical dimension uniformity across the surface of the photoresist on the photomask substrate” (Paragraph [0015] at Page 5, lines 7 - 13 of the present application Specification.)

Exposure of the developed photoresist to the specified vacuum improves the line edge roughness of pattern openings of said developed photoresist.

Applicants’ technique of vacuum treating the non-developed photoresist prior to wet development, or of vacuum treating the photoresist after wet development of the pattern, is applicable to all photoresists on the market, including the one described in the Itoh et al. reference. The specialized photoresist described in the Itoh et al. reference, and its method of use, may help prevent the size of the line written during pattern irradiation from changing during the irradiation process. However, the Itoh et al. reference does not describe a method of equilibration of the latent image in the already patterned photoresist, to achieve an overall improvement in the nominal critical dimension and uniformity across the patterned photoresist.

One of skill in the art would not combine the Kirkpatrick reference with the Itoh et al. reference, as these references pertain to significantly different subject matter. The Examiner has not made a *prima facie* case for the combination of these references.

3. Resolving the level of ordinary skill in the pertinent art.

The question of what is ordinary skill in the pertinent art is very subjective, and applicants would leave this to the Examiner and to a Board of Appeals, if necessary. However, it is safe to say that one of skill in the art will know the difference between the methods used for fabrication of a semiconductor device and the methods used for fabrication of a photomask.

4. Considering objective evidence present in the application indicating obviousness or non obviousness.

The applicants have provided a description of the differences between the art described in the Kirkpatrick reference, the Itoh et al. reference, and the art described in the present application. Applicants contend that even a combination of the art discussed in the two references cited would not lead in the direction of the present invention. In view of the distinctions between applicants' invention and the references cited, the Examiner is respectfully requested to withdraw the rejection of Claims 1 - 17 under 35 U.S.C. § 103(a) as being unpatentable over Kirpatrick in view of Itoh (U.S. Patent Application 2004/0058279).

The Examiner is respectfully requested to pass the application to allowance.

If the Examiner would like to discuss any of the issues with respect to patentability of the amended claims, the Examiner is invited to contact applicants' attorney at the telephone number provided below.

Respectfully submitted,

Shirley L. Church

Shirley L. Church  
Registration No. 31,858  
Attorney for Applicants  
(858) 587-6633

Correspondence Address:  
Patent Counsel  
Applied Materials, Inc.  
P.O. Box 450-A  
Santa Clara, California 95052